

temperatures are such as occur within the thermometer shelters of the Weather Bureau stations.

### MOISTURE.

The quantity of moisture in the atmosphere at any time may be expressed by the weight of the vapor coexisting with the air contained in a cubic foot of space, or by the tension or pressure of the vapor, or by the temperature of the dew-point. The mean dew-points for each station of the Weather Bureau, as deduced from observations made at 8 a. m. and 8 p. m., daily, are given in Table I.

The rate of evaporation from a special surface of water on muslin at any moment determines the temperature of the wet-bulb thermometer, but a properly constructed evaporimeter may be made to give the quantity of water evaporated from a similar surface during any interval of time. Such an evaporimeter, therefore, would sum up or integrate the effects of those influences that determine the temperature as given by the wet bulb; from this quantity the average humidity of the air during any given interval of time may be deduced.

Measurements of evaporation within the thermometer shelters are difficult to make so as to be comparable at temperatures above and below freezing, and may be replaced by computations based on the wet-bulb temperatures. The absolute amount of evaporation from natural surfaces not protected from wind, rain, sunshine, and radiation, are being made at a few experimental stations and will be discussed in special contributions.

*Sensible temperatures.*—The sensation of temperature experienced by the human body and ordinarily attributed to the condition of the atmosphere depends not merely on the temperature of the air, but also on its dryness, on the velocity of the wind, and on the suddenness of atmospheric changes, all combined with the physiological condition of the observer. A complete expression for the relation between atmospheric conditions and nervous sensations has not yet been obtained.

### PRECIPITATION.

[In inches and hundredths.]

The distribution of precipitation for the current month, as determined by reports from about 2,500 stations, is exhibited on Chart III. The numerical details are given in Tables I, II, and III. The total precipitation for the current month was heaviest (14 to 18 inches) in a small portion of western Missouri; it exceeded 6 inches in western Kentucky and the greater part of Illinois, Iowa, and Missouri, as also in eastern Kansas and Nebraska, southern Minnesota, Wisconsin, and Indiana. No rain fell, except an occasional "trace" in New Mexico, Arizona, and the southern portions of California and Nevada. The larger values at regular stations were: St. Louis, 9.1; Omaha, 9.5; Topeka, 9.3; Springfield, Mo., 11.5.

The diurnal variation, as shown by tables of hourly means of the total precipitation, deduced from self-registering gauges kept at the regular stations of the Weather Bureau, is not now tabulated.

The current departures from the normal precipitation are given in Table I, which shows that precipitation was in excess over a region extending from northern North Carolina and southern Virginia westward to Arkansas and Missouri and thence northward to Manitoba, thence west and south-west to the Pacific Coast. The large excesses were: Cairo, 7.0; Cape Henry, 6.7; Springfield, Mo., 5.4; St. Louis and Sault Ste. Marie, 4.5; Astoria, 3.8; Williston, 3.7; Topeka and Duluth, 3.6; Eureka, 3.2; Hannibal, 3.1; Sioux City, 3.0. The large deficits were: Little Rock, 4.4; Charleston and Vicksburg, 3.5; Hatteras, 3.1; Galveston, Meridian, and Jupiter, 3.0.

The average departure for each district is also given in Table

I. By dividing these by the respective normals the following corresponding percentages are obtained (precipitation is in excess when the percentages of the normals exceed 100):

Above the normal: Middle Atlantic, 103; North Dakota, 170; upper Mississippi, 141; Missouri Valley, 145; middle Plateau, 232; northern Plateau, 154; north Pacific, 143; middle Pacific, 144.

Below the normal: New England, 80; south Atlantic, 73; Florida Peninsula, 47; East Gulf, 53; West Gulf, 67; Ohio Valley and Tennessee, 89; lower Lake, 60; upper Lake, 95; northern Slope, 96; middle Slope, 83; southern Slope (Abilene), 19; southern Plateau, 15; south Pacific, 38.

The years of greatest and least precipitation for May are given in the REVIEW for May, 1890. The precipitation for the current month was the greatest on record at: Springfield, Mo., 11.46; Cairo, 10.82; Cape Henry, 10.61; St. Louis, 9.12; Sault Ste. Marie, 6.70; Williston, 5.79; Havre, 4.27; Idaho Falls, 2.78; Winnemucca, 2.77. It was the least on record at: Eastport, 1.00; Pierre, 0.30; Rapid City, 0.60.

The total accumulated monthly departures from normal precipitation from January 1 to the end of the current month are given in the second column of the following table; the third column gives the ratio of the current accumulated precipitation to its normal value.

Districts.	Accumulated departures.	Accumulated precipitation.	Districts.	Accumulated departures.	Accumulated precipitation.
	Inches.	Per ct.		Inches.	Per ct.
North Dakota.....	+ 3.90	162	New England.....	- 3.50	82
Upper Mississippi.....	+ 0.40	103	Middle Atlantic.....	- 1.70	94
Missouri Valley.....	+ 1.50	112	South Atlantic.....	- 4.80	76
Northern Slope.....	+ 0.40	107	Florida Peninsula.....	- 2.70	80
Middle Plateau.....	+ 2.30	134	East Gulf.....	- 6.00	76
North Pacific.....	+ 5.70	119	West Gulf.....	- 3.90	79
Middle Pacific.....	+ 3.10	117	Ohio Valley and Tenn.....	- 6.00	73
			Lower Lakes.....	- 0.40	97
			Upper Lakes.....	- 0.90	83
			Middle Slope.....	- 2.10	77
			Abilene (southern Slope).....	- 5.80	42
			Southern Plateau.....	- 0.80	65
			Northern Plateau.....	- 0.30	97
			South Pacific.....	- 1.80	77

Details as to excessive precipitation are given in Tables XII and XIII.

The total monthly snowfall at each station is given in Table II. Its geographical distribution is shown on Chart VI. The southern limit of freezing temperatures and possible snow is shown on this chart by the isotherm of minimum 32°. The isotherm of minimum 40°, namely, the air temperature within the thermometer shelter, is also given on this chart, and shows approximately the southern limit of frost on exposed surfaces.

### HAIL.

The following are the dates on which hail fell in the respective States:

Alabama, 1, 22, 26. Arizona, 29. Arkansas, 2, 12, 13, 15, 28. California, 4 to 9, 11, 18, 28, 29. Colorado, 21. Connecticut, 31. District of Columbia, 28. Florida, 4, 6, 15, 21. Georgia, 2, 22, 26, 29. Idaho, 1 to 9, 11 to 17, 19 to 23, 25, 26, 28, 29. Illinois, 1, 11 to 21, 25 to 28, 30. Indiana, 1, 4, 11, 13, 18 to 21, 25 to 28. Indian Territory, 16. Iowa, 1, 11 to 14, 16, 17, 18, 23, 24, 26, 27. Kansas, 3, 4, 8 to 23, 25, 26, 27, 29, 30, 31. Kentucky, 1, 2, 11, 19, 26. Louisiana, 13, 14, 20. Maine, 5, 10, 30. Maryland, 12, 18, 19, 26, 28. Massachusetts, 5, 11, 17. Michigan, 4, 6, 11, 12, 14, 25, 27, 28, 30. Minnesota, 7 to 12, 16, 23, 25, 26, 28. Mississippi, 1, 2, 3, 13, 14, 28. Missouri, 1, 2, 11, 12, 13, 15 to 21, 23, 24, 26, 27, 28, 30, 31. Montana, 6, 8, 9, 10, 12, 14, 15, 24, 25. Nebraska, 3, 7, 8, 11, 12, 15, 16, 17, 19, 20, 23, 24, 26, 27. Nevada, 29. New Hampshire, 5, 10, 22, 29, 30. New Jersey, 5, 15, 17, 28,

31. New Mexico, 12. New York, 3, 4, 11, 17, 27, 28, 30. North Carolina, 2 to 5, 14, 17 to 20, 22, 23, 24, 26, 29. North Dakota, 2, 4 to 11, 15, 16, 18, 24, 26, 27, 28, 29. Ohio, 2, 3, 5, 11 to 14, 18, 19, 21, 25, 26, 28, 30. Oklahoma, 13, 16, 21, 27, 28. Oregon, 1 to 5, 8, 9, 11, 12, 14, 16, 17, 20, 21, 22. Pennsylvania, 5, 14, 15, 18, 26, 30. South Carolina, 1, 3, 17, 18, 21, 26, 28. South Dakota, 2, 7, 11, 16, 23, 24. Tennessee, 2, 17, 19, 22, 26, 27, 28, 31. Texas, 1 to 4, 8, 9, 10, 12, 13, 21, 27, 30. Utah, 5, 10, 11, 15, 19, 29. Vermont, 30. Virginia, 12, 13, 18, 19, 22, 26. Washington, 1 to 5, 8, 10 to 16. West Virginia, 12, 13, 14, 18, 24, 25, 26, 29. Wisconsin, 1, 12, 13, 14, 24, 25, 26, 29, 30.

## SLEET.

The following are the dates on which sleet fell in the respective States:

California, 7. Montana, 5, 14, 17, 18, 19. Nevada, 9, 11, 15. Oregon, 1, 2. Washington, 2, 13, 16.

## WIND.

The prevailing winds for May, 1896, viz, those that were recorded most frequently, are shown in Table I for the regular Weather Bureau stations.

The resultant winds, as deduced from the personal observations made at 8 a. m. and 8 p. m., are given in Table IX. These latter resultants are also shown graphically on Chart IV, where the small figure attached to each arrow shows the number of hours that this resultant prevailed, on the assumption that each of the morning and evening observations represents one hour's duration of a uniform wind of average velocity. These figures indicate the relative extent to which winds from different directions counterbalanced each other.

## HIGH WINDS.

Maximum wind velocities of 50 miles or more per hour were reported during this month at regular stations of the Weather Bureau as follows (maximum velocities are averages for five minutes; extreme velocities are gusts of shorter duration, and are not given in this table):

Stations.	Date.	Velocity.	Direction.	Stations.	Date.	Velocity.	Direction.
		Miles				Miles	
Amarillo, Tex.....	8	60	s.	Moorhead, Minn.....	12	63	se.
Buffalo, N. Y.....	28	52	sw.	New York, N. Y.....	18	52	w.
Do.....	29	53	w.	Do.....	19	52	sw.
Cairo, Ill.....	26	60	nw.	North Platte, Nebr.....	6	55	se.
Cheyenne, Wyo.....	11	52	w.	Port Huron, Mich.....	17	54	sw.
Do.....	25	50	w.	Do.....	28	54	sw.
Chicago, Ill.....	14	60	s.	St. Louis, Mo.....	27	80	nw.
Do.....	17	58	sw.	San Antonio, Tex.....	2	60	nw.
Do.....	25	62	s.	Springfield, Ill.....	26	60	nw.
Cleveland, Ohio.....	28	50	w.	Tatoosh Island, Wash.....	8	52	ne.
Davenport, Iowa.....	16	60	nw.	Washington, D. C.....	19	56	nw.
El Paso, Tex.....	12	52	nw.	Do.....	28	54	sw.
Do.....	29	53	sw.	Williston, N. Dak.....	2	60	nw.
Huron, S. Dak.....	7	51	se.	Do.....	10	60	se.
Do.....	9	52	s.	Winnemucca, Nev.....	22	55	s.
Marquette, Mich.....	25	52	se.	Do.....	29	50	sw.

## SUNSHINE AND CLOUDINESS.

The quantity of sunshine, and therefore of heat, received by the atmosphere as a whole is very nearly constant from year to year, but the proportion received by the surface of the earth depends upon the absorption by the atmosphere, and varies largely with the distribution of cloudiness. The sunshine is now recorded automatically at 17 regular stations of the Weather Bureau by its photographic, and at 21 by its thermal effects. At one station records are kept by both methods. The photographic record sheets show the apparent solar time, but the thermometric sheets show seventy-fifth meridian time; for convenience the results are all given in Table XI for each hour of local mean time.

Photographic and thermometric registers give the duration of that intensity of sunshine which suffices to make a record, and, therefore, they generally fail to record for a short time after sunrise and before sunset, because, even in a cloudless sky, the solar rays are then too feeble to affect the self-registers. If, therefore, such records are to be used for determining the amount of cloudiness, they must be supplemented by special observations of the sky near the sun at these times. The duration of clear sky thus specially determined constitutes the so-called twilight correction (more properly a low-sun correction), and when this has been applied, as has been done in preparing Table XI, there results a complete record of the clearness of the sky from sunrise to sunset in the neighborhood of the sun. The twilight correction is not needed when the self-registers are used for ascertaining the duration of a special intensity of sunshine, but is necessary when the duration of cloudiness is alone desired, as is usually the case.

The average cloudiness of the whole sky is determined by numerous personal observations at all stations during the daytime, and is given in the column "average cloudiness" in Table I; its complement, or percentage of clear sky, is given in the last column of Table XI.

## COMPARISON OF DURATIONS AND AREAS.

The details are shown in the following table, in which the stations are arranged according to the greatest possible duration of sunshine, and not according to the observed duration as heretofore.

## Difference between instrumental and personal observations of sunshine.

Stations.	Apparatus.	Total possible duration for the whole month.	Personal estimated area of clear sky.	Instrumental record of sunshine.			
				Photographic.	Difference.	Thermometric.	Difference.
		Hrs.	%	%	±	%	±
Bismarck, N. Dak.....	P.	467.4	46	49	+ 3	.....	.....
Helena, Mont.....	P.	467.4	44	49	+ 5	.....	.....
Portland, Oreg.*.....	P.	464.1	43	34	- 9	.....	.....
Eastport, Me.....	T.	464.1	43	.....	.....	34	- 9
Northfield, Vt.....	P.	460.7	43	60	+17	.....	.....
Portland, Me.....	P.	457.9	42	52	+10	.....	.....
Buffalo, N. Y.....	T.	454.9	46	.....	.....	56	+13
Rochester, N. Y.....	T.	454.7	69	.....	.....	87	+18
Boston, Mass.....	T.	451.9	46	.....	.....	58	+12
Chicago, Ill.....	T.	451.9	66	.....	.....	78	+12
Cleveland, Ohio.....	P.	451.9	52	61	+ 9	.....	.....
Des Moines, Iowa.....	P.	451.9	34	.....	.....	62	+28
Detroit, Mich.....	T.	451.9	63	.....	.....	79	+16
Eureka, Cal.....	P.	449.1	47	53	+ 6	.....	.....
New York, N. Y.....	T.	449.1	46	.....	.....	49	+ 3
Salt Lake City, Utah.....	P.	449.1	26	53	+27	.....	.....
Columbus, Ohio.....	T.	446.7	43	.....	.....	57	+14
Denver, Colo.....	T.	446.7	50	58	+ 8	.....	.....
Philadelphia, Pa.....	T.	446.7	36	.....	.....	64	+28
Baltimore, Md.....	T.	443.8	34	.....	.....	32	- 2
Cincinnati, Ohio.....	T.	443.8	58	.....	.....	80	+24
Kansas City, Mo.....	P.	443.8	40	52	+12	.....	.....
St. Louis, Mo.....	P.	443.8	55	.....	.....	74	+19
Washington, D. C.....	P.	443.8	40	45	+ 5	.....	.....
Dodge City, Kans.....	P.	441.7	58	63	+ 5	.....	.....
Louisville, Ky.....	T.	441.7	52	.....	.....	74	+22
San Francisco, Cal.....	T.	441.7	62	.....	.....	68	+ 1
Santa Fe, N. Mex.....	P.	436.7	64	81	+17	.....	.....
Little Rock, Ark.....	T.	434.2	61	.....	.....	79	+18
Atlanta, Ga.....	T.	432.6	53	.....	.....	86	+33
Wilmington, N. C.....	T.	432.6	55	.....	.....	71	+16
Phoenix, Ariz.....	P.	430.7	80	89	+ 9	.....	.....
San Diego, Cal.....	P.	430.7	65	74	+ 9	.....	.....
Savannah, Ga.....	P.	428.4	59	73	+14	.....	.....
Vicksburg, Miss.....	T.	428.4	73	.....	.....	77	+ 5
New Orleans, La.....	T.	423.7	64	.....	.....	67	+ 3
Galveston, Tex.....	P.	421.8	67	74	+ 7	.....	.....

\* Records by both methods. † Records for only 22 days, for which the total possible duration of sunshine was 322.9 hours. ‡ Records for 25 days; total possible, 364.5 hours.

The sunshine registers give the durations of effective sunshine whence the duration relative to possible sunshine is derived;